FIG. **2** illustrates a scenario where order-related data triggers a shipment to a retailer, in accordance with an example embodiment.

FIG. **3** illustrates a scenario where an event triggers re-routing of a shipment, in accordance with an example embodiment.

FIG. **4** illustrates a scenario where order-related data triggers shipments from a supplier to a manufacturer and from the manufacturer to a warehouse, in accordance with an example embodiment.

FIG. **5** illustrates a scenario where order-related data triggers shipments throughout a supply chain, in accordance with an example embodiment.

FIG. **6** illustrates a scenario where order-related data from a customer triggers shipments throughout a supply chain, in accordance with an example embodiment.

FIG. **7** depicts a system with a warehouse and supply chain coordinator, trucks, and robots associated with a warehouse, in accordance with an example embodiment.

FIGS. **8**, **9**, **10**, **11**, **12**, **13**, **14**, **15**, and **16** illustrate a scenario where trucks arrive, load, unload, and depart a warehouse, in accordance with an example embodiment.

FIG. **17** is a block diagram of a method, in accordance with an example embodiment.

FIGS. **18**, **19**, **20**, and **21** illustrate a scenario where an order is routed to a selected warehouse, in accordance with an example embodiment.

FIG. **22** is a block diagram of another supply chain, in accordance with an example embodiment.

FIG. **23** is a block diagram of still another supply chain, in accordance with an example embodiment.

FIG. **24** is a block diagram of yet another supply chain, in accordance with an example embodiment.

DETAILED DESCRIPTION

Overview

Robots may be deployed within a warehouse to perform automated tasks to facilitate management of inventory at the facility. By using robots in a warehouse, visibility into warehouse operation may be improved. In particular, data from the robots may allow for accurate inventory tracking as well as accurate projections of when inventory may be made available for pickup at the warehouse. Example systems may leverage this data from the robots for higher level optimizations.

When a customer places an order for a shipment of goods, an order management system (OMS) may be responsible for routing the order to a particular warehouse from a group of possible warehouses. To make the routing decision, the OMS may receive periodic communications from the warehouses to reconcile the current available inventory at the warehouses with a log stored by the OMS. However, in some situations, the OMS may not receive regular reconcilements from one or more of the warehouses. Consequently, situations may arise where a customer places an order, the OMS routes the order to a warehouse, and the OMS only learns that the warehouse does not have the needed inventory to satisfy the order when personnel at the warehouse attempt to fill the order. Such scenarios may lead to inefficiencies in order routing as a result of siloing of information between different facilities within a network.

Within examples, an inventory database may be maintained for each of a plurality of warehouses, where each warehouse has its own set of robots. The inventory database indicates available inventory at each warehouse. The inventory database is updated based on messages sent by robots

during the performance of tasks by the robots at each warehouse. An OMS may use the inventory database to determine how to route an order between, e.g., one of three possible warehouses. The visibility into current warehouse state provided by robotic actors may improve the warehouse selection process for order routing.

In order to select a warehouse to receive an order, the OMS may use the inventory database to determine a projected availability time by which an item that satisfies the order will be available for pickup at each of the warehouses. The projected availability time is a clock time or window of time at which the item is expected to be available for pickup at the warehouse (e.g., by a delivery vehicle). In further examples, the projected availability time is a time at which one or more mobile robots at the warehouse are expected to have moved the item to a loading dock at the warehouse. In some examples, the warehouse with the earliest projected availability time for an ordered item may be selected from a plurality of warehouses to receive an order.

In further examples, the inventory database for each warehouse may be updated based on scans of arriving inventory and departing inventory performed at a loading dock by the robots at the warehouse. For example, a mobile robot may be configured to scan each arriving item for a barcode or other on-item identifier after unloading the item from a delivery vehicle. Information identifying the item may be communicated in real-time or near real-time to the OMS, either directly by the robot itself or relayed by a warehouse management system (WMS) of the warehouse in order to update the inventory database. By using sensor data from the robots to reconcile inventory changes, the error bars around currently available inventory at each warehouse in a network may be made much smaller than at manually operated warehouses.

In further examples, the inventory database for each warehouse may include the locations of inventory items within the warehouse. The locations of inventory items at a warehouse may be used to determine the projected availability time for the warehouse. In particular, the fulfillment time for an order may depend on where in a given warehouse the inventory that satisfies the order is currently located. In order to update inventory location information in the inventory database, individual robots or the WMS at each warehouse may be configured to notify the OMS each time an item or pallet has been relocated from one location in the warehouse to another location. In further examples, the locations of inventory items within a warehouse may be updated in response to detections of on-item identifiers (e.g., barcodes) on the inventory items by sensors on the robots in the warehouse. Such detections and database updates may leverage sensor data collected by the robots while performing other operations in the warehouse.

In additional examples, the inventory database for each warehouse may include metrology information for inventory items within the warehouse. The metrology information may also be used to help determine projected availability times for inventory items that will satisfy received orders. Example metrics that may be stored in the inventory database include size, shape, dimensions, weight, and center of mass. In some examples, the metrics may be provided to an OMS based on sensor data from sensors on robots at each warehouse. For instance, when a robot scans incoming inventory, metrology information may be associated with on-item identifiers and provided to the OMS to update the inventory database.

In order to determine the projected availability time for an item that satisfies the order to be available for pickup at a